

Contrace: Traceroute Facility for Content-Centric Network

draft-asaeda-icnrg-contrace-02

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Contrace Overview

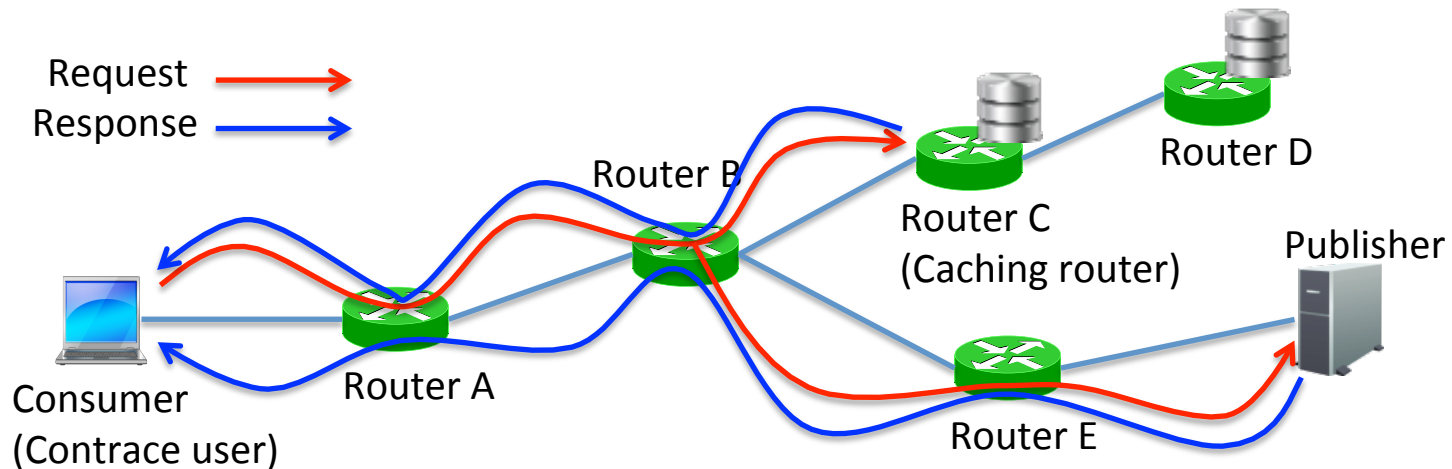
- Protocol analysis tool
 - Caching point/publisher, path stretch
 - Hop count/RTT for content retrieval
 - Cache distribution, cache hit ratio
- Operations, Administration, and Maintenance (OAM) tool
 - Operation
 - Cache lifetime or expiration time
 - Monitoring
 - CS usage at router, num of rcvd interests per cache
 - Multipath forwarding
 - Trouble shooting
 - Availability of caching routers and publishers

Contrace Messages

- Contrace Request Message
 - Request message consists of a fixed header, Request block TLV, Report block TLV(s), and Name TLV
- Contrace Reply Message
 - Reply message consists of a fixed header, Request block TLV, Report block TLV(s), Name TLV, and Reply block/sub-block TLV(s)
- Compatible with CCNx-1.0 TLV format

Contrace Basic Behavior

- **Request message** is initiated by Contrace user and forwarded toward caching router or publisher based on the FIB in a hop-by-hop manner
- Request message includes **Request block** and **Report block(s)**
- **Reply message** is initiated by caching router or publisher and forwarded toward Contrace user based on the PIT entry
- Reply message includes **Reply block** and **Reply sub-block(s)**



Security Considerations

- Policy-Based Information Provisioning for Request
 - Routers can reply the Contrace Reply with the ADMIN_PROHIB return code without appending any Reply (sub-)block TLV
 - Permission, whether (1) All (all cache information is disclosed), (2) Partial (cache information with the particular name prefix can (or cannot) be disclosed), or (3) Deny (no cache information is disclosed), can be defined at routers
- Filtering of Contrace Users Located in Invalid Networks
 - Routers may support an access control mechanism to filter out Requests from invalid Contrace users located in invalid networks

Security Considerations – cont'd

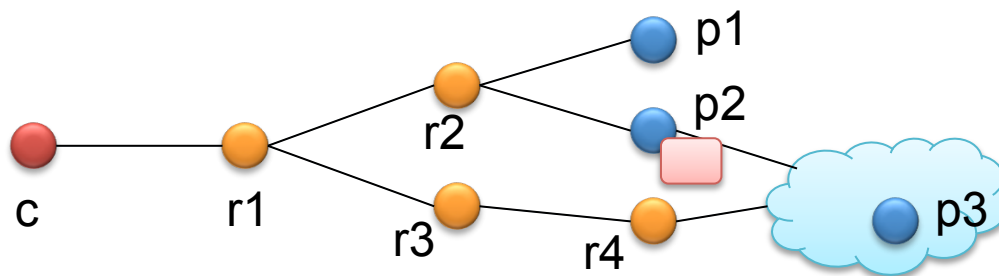
- Topology Discovery
 - If a network topology is a secret, Contrace Requests may be restricted at the border of the domain, using the ADMIN_PROHIB return code
- Characteristics of Content
 - If publisher or content information is secret, Contrace Requests may be restricted at the border of the domain, using the ADMIN_PROHIB return code
- Shortening Contrace Reply Timeout
 - Routers may configure the shorter timeout value to time out the Request
- Limiting Request Rates
 - Routers may rate-limit Contrace Requests by ignoring some of the consecutive messages.

Security Considerations – cont'd

- Limiting Reply Rates
 - Routers in the traced path may rate-limit Contrace Replies.
- Adjacency Verification
 - Forwarding Contrace messages given from non-adjacent neighbor nodes/routers must be prohibited
 - Defining the secure way to verify the adjacency cannot rely on the way specified in CCNx message format or semantics; therefore a new TLV for adjacency verification using hop-by-hop TLV header will be defined in a separate document.

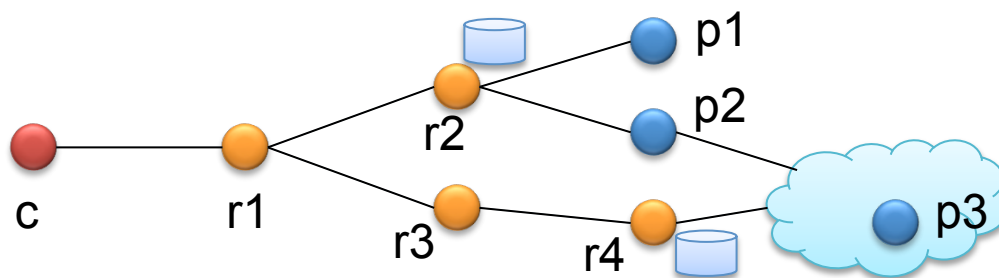
Ex.1. contrace ccnx:/news/science

```
cefuser@ceflab:~$  
cefuser@ceflab:~$ contrace ccnx:/news/science  
contrace to ccnx:/news/science with HopLimit=32, SkipHopCount=0, Flag=0x0000 and Request ID=142  
  
response from publisher2: no error, time=1.699000 ms  
  
route information:  
1 consumer          0.119 ms  
2 router1           0.442 ms  
3 router2           0.261 ms  
4 publisher2        0.376 ms  
  
cache information:  prefix      size      cobs      interests  start-end  lifetime  expire  
1 p ccnx:/news/science/  8658 KB   8456      0          0-8455    634 secs  2951 secs  
  
cefuser@ceflab:~$
```



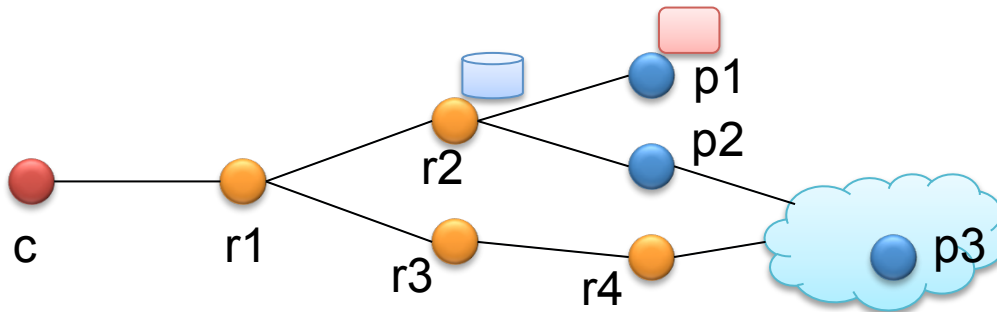
Ex.2. contrace -n ccnx:/video/video1

```
cefuser@ceflab:~$  
cefuser@ceflab:~$ contrace -n ccnx:/video/video1  
contrace to ccnx:/video/video1 with HopLimit=32, SkipHopCount=0, Flag=0x0002 and Request ID=11717  
  
response from router2: no error, time=1.516000 ms  
  
route information:  
1 consumer          0.715 ms  
2 router1           0.228 ms  
3 router2           0.275 ms  
  
response from router4: no error, time=2.136000 ms  
  
route information:  
1 consumer          0.715 ms  
2 router1           0.228 ms  
3 router3           -2.128 ms  
4 router4           3.231 ms  
  
cefuser@ceflab:~$
```



Ex.3. contrace -o ccnx:/news/today

```
cefuser@ceflab:~$  
cefuser@ceflab:~$ contrace -o ccnx:/news/today  
contrace to ccnx:/news/today with HopLimit=32, SkipHopCount=0, Flag=0x0004 and Request ID=29932  
response from publisher1: no error, time=1.888000 ms  
route information:  
1 consumer          0.142 ms  
2 router1           0.357 ms  
3 router2           0.340 ms  
4 publisher1       1.198 ms  
cache information:  prefix      size      cobs      interests  start-end  lifetime  expire  
1 p ccnx:/news/today/ 1565 KB   1529      5          0-1528    204 secs  3319 secs  
cefuser@ceflab:~$
```

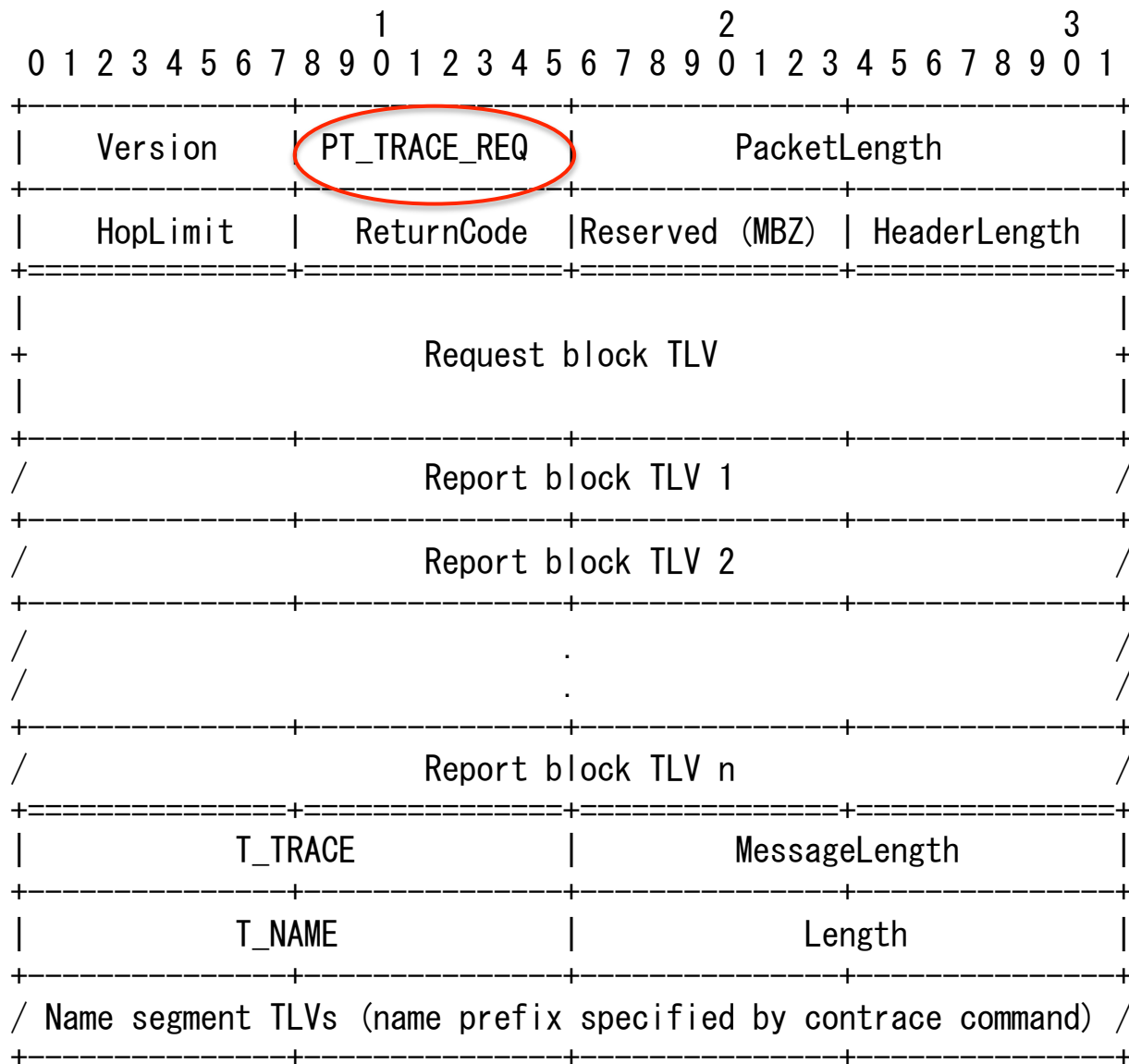


Summary

- Contrace, which is compatible with CCNx-1.0 TLV format, is a powerful network tool providing various information, e.g.,
 - Caching point/publisher, path stretch
 - Hop count/RTT for content retrieval
 - Cache distribution, cache hit ratio
 - Cache lifetime or expiration time
 - CS usage, num of received interests
- Security considerations discussed
- Experiments with a running code
 - Contrace, *IEEE ComMag*, Mar. 2015.
 - New Contrace (proposed in this I-D) is also implemented and tested
- On going
 - Contrace-NDN specification (in a separate document)

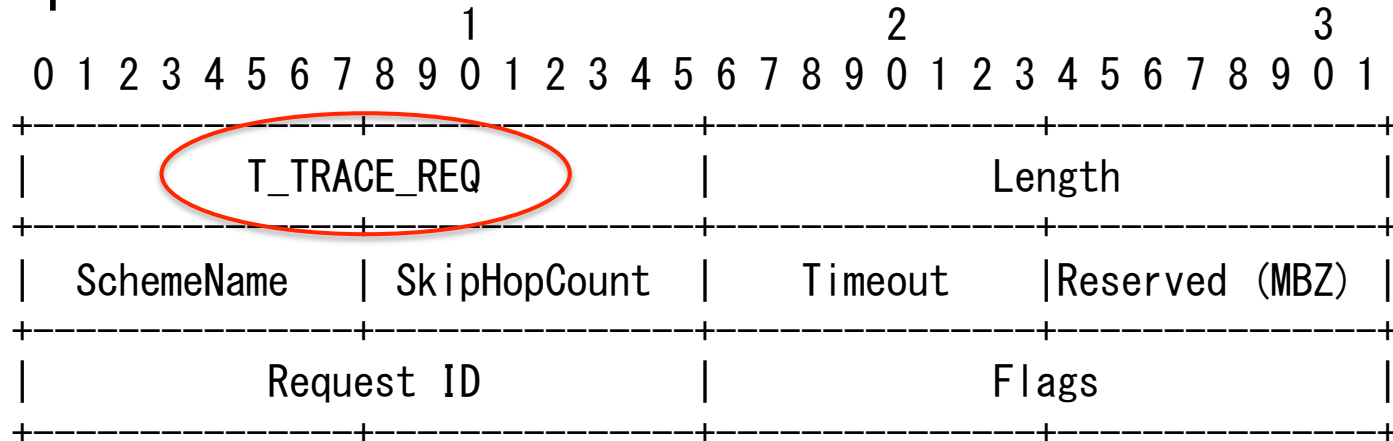
Backup

Request Message

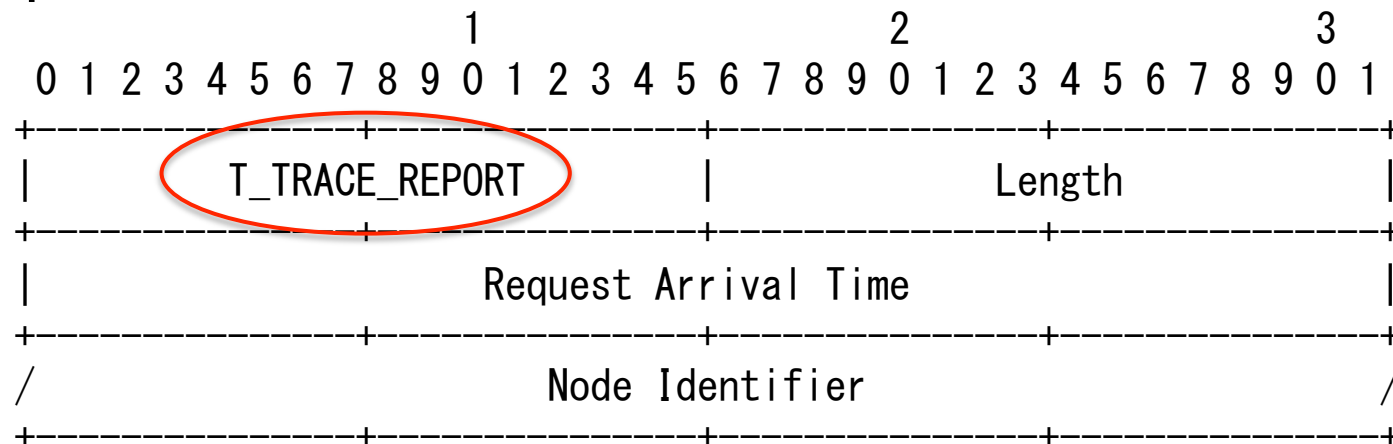


Request Block and Report Block

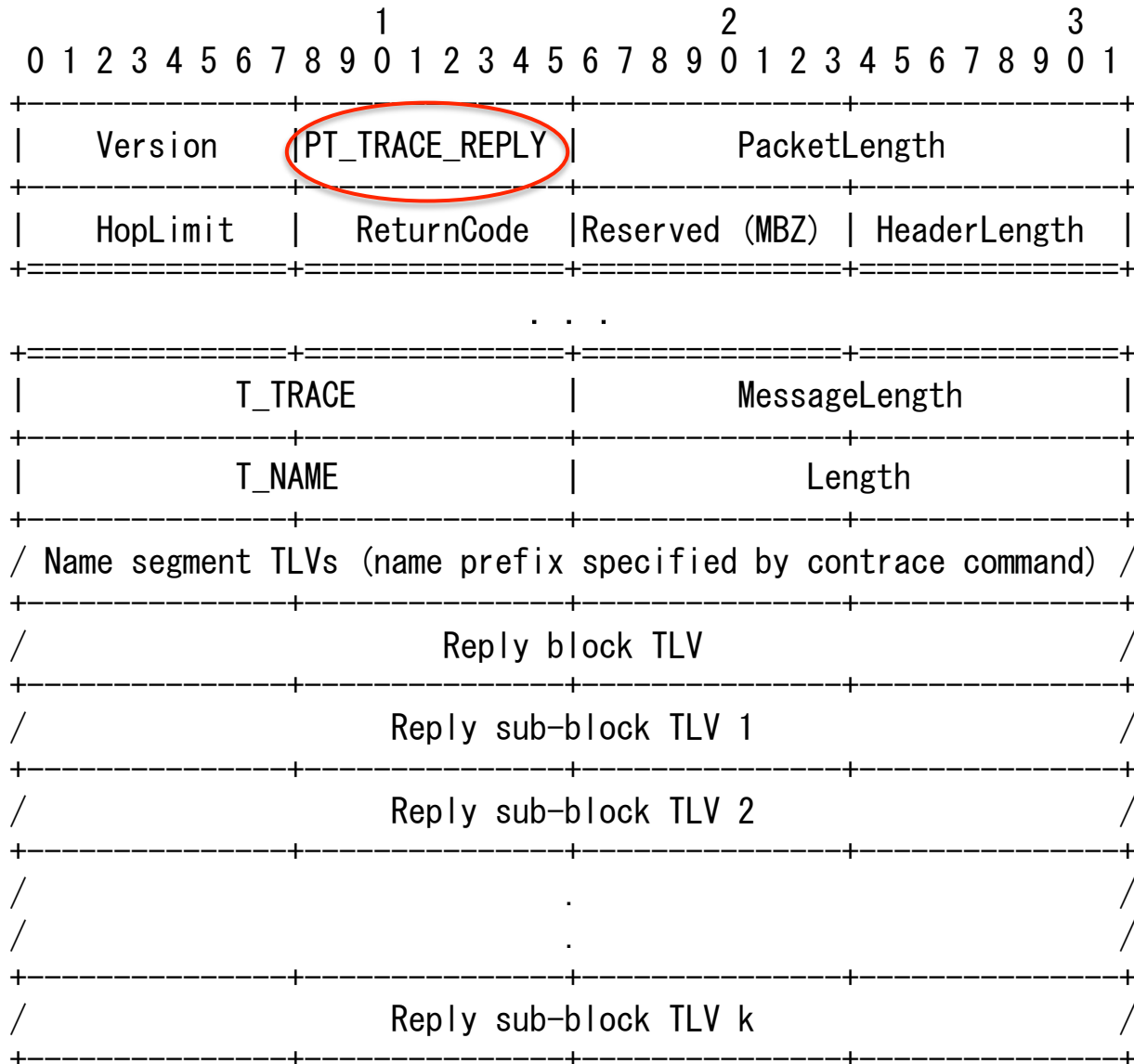
■ Request block



■ Report block



Reply Message



Reply Sub-Block

